ANALYSIS OF SERUM CHEMISTRIES OF FREE-RANGING FERAL HORSES AND BURROS IN RELATION TO LOCATION, CONDITION, AND REPRODUCTION

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REPORT

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CONTENTS

INTRODUCTION

Pregnancy rates, population growth, animal condition, and habitat condition are recurring themes of feral horse management. There are substantial difficulties in determining population growth rates. It is not clear what environmental factors influence pregnancy and foal survival rates from year to year or between different locations.

Differences in condition of horses, which might influence demographic parameters, have been evaluated primarily by observation whether through use of a structured index or a general impression with no systematic analysis.

This study was designed to take advantage of the fact that data were being collected on body measurements, pregnancy status, and a condition evaluation index of feral mares collected from different locations and populations during a single season. This provided an opportunity to correlate physiological data with reproduction and condition data and to assess whether physiological differences could be related to differences in origin (location and population) of the animals, lactation, pregnancy, and condition.

MATERIALS AND METHODS

Blood samples were collected from the feral horses and burros by Wolfe and colleagues as part of a pregnancy rate study under BLM Contract No. AA851-CT1-51. A portion of the separated serum was stored at -80 C until made available for this study. The serum chemistry assays were done by automated procedures (Seal et al.). The physical (condition, weight, measurements, and age) and pregnancy determination (rectal palpation and serum hormones [progesterone, estradiol, PMSG]) data were collected by Wolfe and Ellis as described in their report. Lactation was evaluated by observation of the udder.

The data set and the code and label for each variable are tabulated in Tables 1a & 1b. Statistical analyses were done with the NCSS package of Hinze (1987). A generalized linear model was used for the ANOVA analyses. The notched box plots in the figures are based upon medians and percentiles of the distribution. The line through the box represents the 50th percentile (median) of the of the data, the ends of the box are the 25th and 75th percentiles, and the lines extending from each end reach to the 10th and 90th percentiles. The notches are constructed from the formula:

$$\text{MEDIAN} \pm 1.57 * (75\text{th \%tile} - 25\text{th \%tile}) / \sqrt{n}$$

Comparing boxes in the same plot, the medians are different at the 95% level of significance if the notches of two boxes do not overlap.

Table 1a. A listing of the labels indicating the contents of the database used for these analyses (the extended chemistry data set is listed in Table 1b).

No.	Variable	Rows	Vlab	Label
1	C1	654	Seq	SEQUENCE NUMBER
2	C2	654	ID	ID NUMBER
3	C3	654	Date	DATE YYMMDD
4	C4	654	Species	SPECIES 1=BURROS 2=HORSES
5	C5	654	Locat	CAPTURE LOCATION 1 - 5
6	C6	654	Pop	POPULATION
8	C8	654	Lact	LACTATION STATUS 1=YES 2=NO
9	C9	654	Palp	PALPATION - PREGNANCY
10	C10	654	Cond	CONDITION ESTIMATE
11	C11	654	EWGT	ESTIMATED WEIGHT
12	C12	654	MWGT	MEASURED WEIGHT
13	C13	654	CWGT	CALCULATED WEIGHT
14	C14	654	Hgt	HEIGHT
15	C15	654	Girth	GIRTH
16	C16	654	Length	LENGTH
17	C17	654	Prog	PROGESTERONE NG/ML
18	C18	654	Estrad	ESTRADIOL PG/ML
19	C19	654	PMSG	PMSG
20	C20	654	Foals	FOALS
21	C21	654	Lipemia	LIPEMIA INDEX
22	C22	654	Hemol	HEMOLYSIS INDEX
23	C23	654	SUN	SERUM UREA NITROGEN - MG/DL
24	C24	654	Trigs	TRIGLYCERIDES - MG/DL
25	C25	654	Chol	CHOLESTEROL - MG/DL
26	C26	654	Ca	CALCIUM - MG/DL
27	C27	654	P	PHOSPHORUS - MG/DL
28	C28	654	PWGT	WEIGHT - POUNDS
29	C29	654		
30	C30	654		PREGNANCY: 1=YES 2=NO

GLM ANOVA (Variable Labels)

No.	Variable	Rows	Label	No.	Variable	Rows	Label
[illegible]	[illegible]	93	ID Number	21	C21	93	SGOT
2	C2	93	Population	22	C22	93	Alkaline P'tase
3	C3	93	AGE	23	C23	93	GGT
4	C4	93	Lactation	24	C24	93	LDH
5	C5	93	Palpation	25	C25	93	Uric Acid
6	C6	93	Condition	26	C26	93	Sodium
7	C7	93	Estimated Weight	27	C27	93	Potassium
8	C8	93	Measured Weight	28	C28	93	Chloride
9	C9	93	Calculated Weight	29	C29	93	Carbon Dioxide
10	C10	93	Height	30	C30	93	Serum Urea
11	C11	93	Girth	31	C31	93	Creatinine
12	C12	93	Length	32	C32	93	Glucose
13	C13	93	Progesterone ng/ml	33	C33	93	Calcium
14	C14	93	Estradiol pg/ml	34	C34	93	Phosphorus
15	C15	93	PMSG	35	C35	93	Cholesterol
16	C16	93	Foals	36	C36	93	Triglycerides
17	C17	93	Serum Protein	37	C37	93	WEIGHT - pounds
18	C18	93	Albumin	38	C38	93	PREGNANCY - HORMONE
19	C19	93	Total Bilirubin	39	C39	93	GLOBULINS - G/DL
20	C20	93	Direct Bilirubin	40	C40	93	A/G RATIO

Enter *DDY* to continue, Variable, or ESC to quit -- *zzzzzzz*

Table 1b. A listing of the labels indicating the contents of the database used for the analysis of the extended chemistry data set.

Table 2. Capture locations and dates of handling the feral horses and burros for collection of blood samples analyzed in this study.

Location		Population		N	Dates (YYMMDD)
Wyoming	1				
			2	94	810902-04, 811013-16
			3	49	811027-28, 811202
			4	21	810901
			5	49	810825-27
Nevada	2				
			1	17	820209
			2	116	811001, 811103-05,09,
811213					
			3	56	811001, 811105-09
			4	24	811102
Oregon	3				
			1	48	820217-19
			2	27	820216-17
Oregon	4				
			1	11	820207
			2	30	820204-06
			3	6	820203-04
California	5				
		Redwood	1	46	820425
			2	107	820327-31, 820409-10
			3	34	820422

RESULTS

SAMPLES

Sample Collection:

Feral horse populations collected at locations in Nevada, Wyoming, Colorado, and Oregon were sampled (Table 2). Collection dates ranged from August 1981 to February 1982 for the horses. All of the mares in the Oregon populations were collected during February 1982. These differences in dates of collection must be considered in interpretation of possible differences between locations. Mares would be at different stages of pregnancy, food resources differ with season, and horses may have endogenous seasonal metabolic rhythms. The burros were collected from three populations at a single location in California over a four week period March - April 1982 which should minimize location and seasonal differences.

Sample Condition:

The serum samples were examined and scored on a 4 point scale for condition in terms of visible lipemia (Table 3) and hemolysis (Table 4). Sixty-three percent of the samples had no visible evidence of either lipemia or hemolysis. The samples were either hyperlipemic or hemolyzed since only 15 samples were positive for both (Table 5). Hyperlipemia was evident as serum turbidity in 151 samples (23.3%) with 65 in the horses from Nevada (location 2) and 77 in the burros (location 5) (Table 6). Hemolysis was evident in 134 samples (20.7%) with the highest proportion (49) in the Oregon samples (Table 7). Burro samples had a higher incidence ($x^2 = 51.2$, df = 3, $p < 0.0001$) of lipemia than horses and the same incidence of hemolysis (Table 3). This hyperlipemia is reflected in high serum triglycerides in the same samples (Fig. 1) and suggests either a recent high fat intake or a fasting mobilization of fat.

Table 3. Tabulation of degree of lipemia in serum samples of horses and burros.

		LIPEMIA INDEX				
SPECIES		0	1	2	3	Total
Burros	1	111	25	30	22	188
Horses	2	385	31	32	11	459
Total		496	56	62	33	647

Chi-Square with 3 degrees of freedom = 51.2115.
Probability Level = 0.0000.

Table 4. Tabulation of degree of hemolysis in serum samples of horses and burros.

		HEMOLYSIS INDEX				
SPECIES		0	1	2	3	Total
Burros	1	159	15	12	2	188
Horses	2	354	48	42	15	459
Total		513	63	54	17	647

Chi-Square with 3 degrees of freedom = 5.4651.
Probability Level = 0.1407.

TABLE 5. Cross tabulation of hemolysis and lipemia in the horse and burro serum samples.

LIPEMIA INDEX		HEMOLYSIS INDEX 0	1	2	3	Total
(N)	0	471	52	52	17	592
(%)		63.4	7.0	7.0	2.3	79.7
(CHI^2)		0.3	0.1	1.2	0.9	2.5
	1	46	8	2	0	56
		6.2	1.1	0.3	0.0	7.5
		0.0	2.2	1.2	1.3	4.7
	2	58	3	1	0	62
		7.8	0.4	0.1	0.0	8.3
		1.1	1.0	2.9	1.4	6.3
	3	32	0	1	0	33
		4.3	0.0	0.1	0.0	4.4
		0.9	2.8	0.9	0.8	5.4
Total		607	63	56	17	743
		81.7	8.5	7.5	2.3	100.0
		2.3	6.1	6.2	4.3	18.9

Chi-Square with 9 degrees of freedom 18.9007
Probability Level 0.0261.

Table 6. Distribution among collection locations of degree of lipemia in serum samples.

LOCATION		LIPEMIA INDEX 0	1	2	3	Total
Wyoming	1	117	2	4	1	124
Nevada	2	148	28	27	10	213
Oregon	3	75	0	0	0	75
Oregon	4	45	1	1	0	47
Burros	5	111	25	30	22	188
Total		496	56	62	33	647
	%	76.7	8.7	9.6	5.1	100.0

Chi-Square with 12 degrees of freedom 99.3027.
Probability Level 0.0000.

Table 7. Distribution among collection locations of degree of hemolysis in serum samples.

LOCATION		HEMOLYSIS INDEX 0	1	2	3	Total
Wyoming	1	101	15	5	3	124
Nevada	2	180	20	11	2	213
Oregon	3	54	7	12	2	75
Oregon	4	19	6	14	8	47
Burros	5	159	15	12	2	188
Total		513	63	54	17	647
	%	79.3	9.7	8.3	2.6	100.0

Chi-Square with 12 degrees of freedom 91.2208.
Probability Level 0.0000.

SERUM CHEMISTRIES

Species Comparisons:

The serum samples were assayed for a group of metabolic indicators (urea, cholesterol, triglycerides, calcium, and phosphorus) which have been shown to be useful for physiological comparisons in horses and other species (Seal et al. 1978, 1983, 1985). Details of the descriptive statistics and t-tests comparing the two species for the 5 chemistry assays and body weight are in Appendix 1. Horses and burros had different ($p < 0.0001$) mean levels for each of the five serum chemistries (Table 8) with the jennies higher on 4 of the 5 assays. The jennies were less than one-half the weight of the mares and had an average age of 37 months in contrast to 52 months for the horses.

Table 8. Comparison of feral female horse and burro body weights and serum chemistries.

Assay	Horses		Burros		P<
	Mean	S.E.	Mean	S.E.	
Urea Nitrogen	20.5	.28	18.8	.44	0.001
Triglycerides	117	8.4	333	37.6	0.0000
Cholesterol	102	1.5	146	6.6	0.0000
Calcium	11.6	.08	13.4	.23	0.0000
Phosphorus	2.51	.06	5.93	.16	0.0000
Weight	776	9.1	321	11.3	0.0000
Age - Months	52.1	1.8	37.2	2.2	0.0000

Comparisons were made by the "t"-test for unpaired variates. Sample sizes for the horses ranged from 390 to 450 and for the burros from 164 to 182 except for body weight, burros = 42 and horses = 379.

Location Comparisons:

There were significant differences between locations for each of the five chemistry assays (Table 9). Details of the analyses are in Appendix 2. Serum urea values ranged from 5 to 45 mg/dl in the horses and burros (Fig. 2) with small but significant differences in means between locations for the horses (Table 9). The mean in the Wyoming mares was higher than in the Nevada animals ($P < 0.001$). Serum triglycerides were lower in the Wyoming than in the Nevada animals and had fewer widely dispersed values (Figs. 1 & 3) ($P < .001$). The Oregon animals had intermediate levels. Serum cholesterol levels were higher in the Wyoming than in the Nevada mares (Fig. 4) ($P < .001$). Serum calcium (Fig. 5) was lowest in the Wyoming mares ($P < .001$) and highest in the Nevada mares. Serum phosphorus (Fig. 6) was higher in the Wyoming mares than in the other locations ($P < .001$) and lowest in one of the Oregon locations ($P < .001$).

Table 9. Comparisons of serum chemistries of the mares from each of the four collection locations.

		MEANS				
Location	N	Urea	Trigs	Chol	Ca	P
Wyoming	213	21.3	75	114	10.5	3.3
Nevada	212	19.5	133	94	12.3	2.4
Oregon	27	21.0	103	93	11.4	1.7
Oregon	40	18.2	103	136	12.1	2.6
ANOVA	P <	.0005	.001	.0001	.0001	.0001

All means are in mg/dl. Means were compared with Fisher's least significant difference for alpha = .05, .01, and .001 as appropriate. Details of the analyses are presented in Appendix 2.

Population Comparisons:

Burros: There were significant differences between populations for serum phosphorus and marginally for cholesterol (Table 10). The box plots (Figs. 7-10) suggest that population #2 may be more heterogenous than the other burro populations. Details of the analyses are in Appendix 3a. Population #3 had lower serum phosphorus than the other two populations (P < .001). This difference can not be attributed to age since the burro population did not differ in age.

Table 10. Comparisons of serum chemistries of the jennies from each of the three California burro populations.

		MEANS				
Population	N	Urea	Trigs	Chol	Ca	P
#1	46	19.0	208	120	13.7	6.60
#2	101	18.4	348	152	13.4	6.02
#3	34	19.8	465	149	13.4	4.86
ANOVA	P<	NS	.076	.052	NS	.001

All means are mg/dl. Means were compared with Fisher's least significant difference for alpha = .05, .01, and .001 as appropriate. Details of the analyses are presented in Appendix 3a.

Wyoming mares: There were significant differences between populations for four of the chemistry assays, but not phosphorus (Table). The box plots of the serum chemistries (Figs. 11-15) suggest that population #2 is more heterogenous in its nutritional resources than the other 3 populations. Details of the analyses are in Appendix 3b. Population #3 had lower urea than 2, 4, & 5 (P < .0001), lower triglycerides and lower cholesterol than 2 & 4 (P < .01).

Table 11. Comparisons of serum chemistries of the mares from each of the four Wyoming mare populations.

		MEANS				
Population	N	Urea	Trigs	Chol	Ca	P
#2	92	22.1	110	126	10.8	3.33
#3	49	17.2	34	101	10.6	3.14
#4	20	24.7	68	118	9.7	3.20
#5	48	23.3	56	105	10.2	3.45
ANOVA	P<	.0001	.0001	.0001	.0004	NS

All means are mg/dl. Means were compared with Fisher's least significant difference for alpha = .05, .01, and .001 as appropriate. Details of the analyses are presented in Appendix 3b.

Nevada mares: There were significant differences between populations for all five of the chemistry assays (Table 12). The box plots (Figs 16-20) of the serum chemistries indicate that population #2 was more heterogenous in nutritional status than the other three populations. Details of the analyses are in Appendix 3c. Population #3 had a lower serum phosphorus (P < .001) and a higher serum urea (P < .001) than the other three populations.

Table 12. Comparisons of serum chemistries of the mares from each of the four Nevada mare populations.

		MEANS				
Population	N	Urea	Trigs	Chol	Ca	P
#1	17	20.3	95	80	11.7	2.67
#2	115	17.3	169	99	12.6	2.59
#3	56	24.3	95	87	12.0	1.71
#4	24	18.4	72	91	12.2	2.80
ANOVA	P<	.0001	.02	.007	.004	.0001

All means are mg/dl. Means were compared with Fisher's least significant difference for alpha = .05, .01, and .001 as appropriate. Details of the analyses are presented in Appendix 3c.

Oregon mares: The numbers of samples available from the populations from these locations (#3 and #4) were small. The pooled data for each location are most useful. There were population differences at Location 4 for urea and triglycerides.

Table 13. Comparisons of serum chemistries of the mares from each of the three Oregon (Location 4) mare populations.

		MEANS (mg/dl)				
POPULATION	N	Urea	Trigs	Chol	Ca	P
#1	10	20.7	70		12.2	2.67
#2	26	17.3	64		11.9	2.59
#3	5	20.1	286		13.0	2.49
ANOVA	P<	.02	.007		NS	NS

Lactation Effects:

Lactation output places increased demands on the mare's energy and protein resources and can serve as a nutritional stressor to animals on limited nutrition. This can result in a failure to successfully breed and the presence of adult mares in the fall and winter population that are not pregnant or pregnant animals that are not lactating. Variations in both proportions were evident in the populations samples for this study. The effects of lactation were examined for each of the serum chemistries by 2-way ANOVA (2 factors, one 'lactation' and another independent variable (species, location, population).

Species: There were significant species differences for each of the chemistries (Table 8). Lactation effects are thus best analyzed within each species. Triglycerides were higher in the dry females in both species and cholesterol was higher only in the burros.

Table 14. Lactation effects on serum chemistries for all burros and horses without regard to location and population effects.

SPECIES AND LACTATION

ASSAY	Horses		Burros		P<	
	Wet	Dry	Wet	Dry	Species	Lact.
Urea Nitrogen	21.1	19.9	19.4	18.7	.05	NS
Triglycerides	92	110	145	350	.0001	.004
Cholesterol	106	102	119	149	.0001	.05
Calcium	11.0	11.7	132.	13.4	.0001	NS
Phosphorus	2.56	2.73	5.62	5.95	.0001	NS
Weight	866	756		321		
Age	74	41	58	35	.02	.0001

Data presented are means (mg/dl). Comparisons were made by 2-way ANOVA with interaction. Sample sizes for the horses ranged from 390 to 450 and for the burros from 164 to 182 except for body weight, burros = 42 and horses = 379.

Location: There were significant location effects for each of the five chemistries (Table 15). Phosphorus was higher in non-lactating mares at all locations. There appear to be lactation effects on urea and calcium (lower and higher respectively in the non-lactating mares) at location 1 (Wyoming) with minimal differences at the other locations. These relationships in two of the Wyoming populations are examined in greater detail in another section.

Table 15. Lactation effects on the serum chemistries of the mares from each of the four locations.

	LOCATIONS				P<	
ASSAY	1	2	3	4	Loc	Lac
Urea Nitrogen						
Wet	23.5	18.2		17.5	.0001	NS
Dry	19.7	20.0	21.0	18.6		
Triglycerides						
Wet	78	116		83	.05	NS
Dry	74	140	104	111		
Cholesterol						
Wet	117	87			.0001	NS
Dry	112	96	93	135		
Calcium						
Wet	10.1	12.2		12.4	.0001	NS
Dry	10.9	12.4	11.4	11.9		
Phosphorus						
Wet	2.80	2.20		2.40	.0001	.001
Dry	3.72	2.45	1.68	2.71		

The values are means (mg/dl).

Populations: Variation in population and lactation effects on serum chemistries were examined for the Wyoming and Nevada horse locations and for the burros (the Wyoming populations will be described in greater detail below).

There were population effects (P< .001) for urea, triglycerides, cholesterol, and calcium in the Wyoming horses. There were lactation effects (P< .001) for urea, calcium and phosphorus. The lactating animals had high urea, low calcium, and low phosphorus. These effects were consistent across populations. There were no significant interaction effects. Population 3 had low urea, triglycerides, cholesterol, and phosphorus.

Table 16a. Lactation effects on the serum chemistries of the mares from each of the four Wyoming populations.

	POPULATION				P<	
ASSAY	2	3	4	5	Pop	Lac
Urea Nitrogen						
Wet	22.8	21.3	27.0	24.4	.0001	.0001
Dry	21.2	15.9	21.8	22.6		
Triglycerides						
Wet	100	33	65	53	.0002	NS
Dry	121	35	73	58		
Cholesterol						
Wet	123	103	114	112	.0001	NS
Dry	129	100	121	100		
Calcium						
Wet	10.4	10.5	9.0	9.6	.0001	.0001
Dry	11.4	10.6	10.6	10.5		
Phosphorus						
Wet	2.69	2.85	2.76	3.04	NS	.0001
Dry	4.12	3.23	3.80	3.74		

The values are means (mg/dl).

The effect of population was significant for urea, cholesterol, and phosphorus for the Nevada horses (Table 16b). There were no simple lactation effects in these mares but there was an interaction effect for phosphorus which was lower in three of four populations in the non-lactating mares. Population 2 had the lowest urea and highest triglyceride, cholesterol, and calcium levels.

For burros, only serum phosphorus exhibited population differences. There were no lactation effects between populations.

Table 16b. Lactation effects on the serum chemistries of the mares from each of the four Nevada mare populations.

	POPULATION				P<	
ASSAY	1	2	3	4	Pop	Lac
Urea Nitrogen						
Wet		17.5	21.4	20.8	.0001	NS
Dry	20.5	17.3	24.7	17.9		
Triglycerides						
Wet		126	71	94	NS	NS
Dry	99	199	98	68		
Cholesterol						
Wet		80	76	84	.04	NS
Dry	80	104	89	93		
Calcium						
Wet		12.3	11.8	11.9	.08	NS
Dry	11.6	12.8	12.1	12.2		
Phosphorus						
Wet		2.05	2.22	3.72	.003	NS
Dry	2.64	2.95	1.64	2.62		

The values are means (mg/dl).

Lactation and Pregnancy Effects:

Since there were effects associated with lactation in some serum chemistries and other variables and since the distribution of animals among the four possible combinations of lactation and pregnancy was unequal (Tables 17 & 18), analysis of pregnancy effects requires consideration of lactation effects at the same time. Relationships are further confounded by age effects since the incidence of lactation was age dependent. Analysis for pregnancy effects was initiated with 2-way ANOVA using age as a covariate.

Species: Only horses were analyzed because of sample sizes available. Although within horses location effects are also a factor, data for all horses were examined first. There were only 15 mares diagnosed as non-pregnant and lactating so this group is small (Table 18). In the covariance analysis, significant age effects were found for triglycerides ($P < .02$), calcium ($P < .005$), and phosphorus ($P < .0001$). The only other significant effect was for lactation and calcium ($P < .02$) with lactating animals having lower calcium.

Location: Insufficient data except for Wyoming and Nevada sites. No pregnancy effects noted.

Population: See the detailed analysis of the mares from the Wyoming location below.

Table 17. Cross tabulation of pregnancy and lactation rates of burros.

	PREGNANT		
LACTATION	YES	NO	Total
YES	17	2	19
	8.9	1.0	9.9
	0.2	0.8	1.0
NO	137	35	172
	71.7	18.3	90.1
	0.0	0.1	0.1
Total	154	37	191
	80.6	19.4	100.0
	0.2	0.9	1.1

Chi-Square with 1 degrees of freedom 1.0569.
Probability Level 0.3039.

Table 18 . Cross tabulation of pregnancy and lactation rates of mares.

	PREGNANT		
LACTATION	YES	NO	Total
YES	150 28.1 0.9	16 3.0 4.5	166 31.1 5.4
NO	297 55.6 0.4	71 13.3 2.0	368 68.9 2.4
Total	447 83.7 1.3	87 16.3 6.5	534 100.0 7.8

Chi-Square with 1 degrees of freedom 7.8193. Probability Level 0.0052.

PHYSICAL DATA (Age, Body Weight, and Condition)

Species Comparisons:

Age: The mean age of the mares was 52.1 ± 1.81 months and for the jennies was 37.2 ± 2.23 months (Table 8, Appendix 6).

Weight: The mares averaged 776 ± 9.1 pounds in contrast to 321 ± 11.3 pounds for the jennies (Table 8).

Condition Index: The mean condition index for 340 mares from locations 1, 2, and 3 was 46.8 ± 0.41 (Appendix 6). No condition evaluation was made of the burros.

Table 26. Proportions of lactating and dry mares at each of the four horse handling locations and for the burros.

		LACTATION STATUS	
LOCATION	WET	DRY	Total
Wyoming 1	63	61	124
	9.7	9.4	19.2
	36.6	11.6	48.3
Nevada 2	59	154	213
	9.1	23.8	32.9
	1.1	0.4	1.5
Oregon 3	0	75	75
	0.0	11.6	11.6
	18.1	5.7	23.8
Oregon 4	15	32	47
	2.3	4.9	7.3
	1.2	0.4	1.6
Burros 5	19	169	188
	2.9	26.1	29.1
	15.3	4.9	20.2
Total	156	491	647
	24.1	75.9	100.0
	72.4	23.0	95.3

Chi-Square with 4 degrees of freedom = 95.3376 with probability level of 0.0000 .

Table 27. Pregnancy rates by species.

SPECIES	PREGNANT YES	NO	Total
Burros	154	37	191
	80.6	19.4	100.0
Horses	447	87	534
	83.7	16.3	100.0
Total	601	124	725
	82.9	17.1	100.0

Chi-Square 0.9410. P = 0.3320.

Table 28. Pregnancy rates by location.

LOCATION	PREGNANT YES	NO	Total
1	188	11	199
	94.5	5.5	100.0
	3.2	15.6	18.8
2	167	46	213
	78.4	21.6	100.0
	0.5	2.5	3.0
3	57	18	75
	76.0	24.0	100.0
	0.4	2.1	2.5
4	35	12	47
	74.5	25.5	100.0
	0.4	2.0	2.4
Burros 5	154	37	191
	80.6	19.4	100.0
	0.1	0.6	0.7
Total	601	124	725
	82.9	17.1	100.0
	4.7	22.7	27.4

Chi-Square, 4 df 27.4041. P< 0.0000.

Lactating and Pregnant: The proportion of females recorded as pregnant and lactating was 3-fold higher among the horses (28.1 %) (Table 29) than the burros (9.0 %) (Table 30). The proportion neither lactating or pregnant was 13.3 % in the horses and 17.6 % in the burros. Tabulation of the horse data by location (Tables 31-34) also provides a partial subdivision by date of observation. The proportion of mares evaluated as pregnant (combination of palpation and hormone data) and lactating was highest at location #1 - collected earliest in the season.

Table 29. Cross tabulation of pregnant and lactating mares for all locations.

	LACTATION			
PREGNANT	WET	DRY	Total	
YES	121	251	372	N
	26.4	54.7	81.0	%
	0.9	0.4	1.3	Chi^2
NO	16	71	87	
	3.5	15.5	19.0	
	3.8	1.6	5.5	
Total	137	322	459	
	29.8	70.2	100.0	
	4.7	2.0	6.7	

Chi-Square with 1 degrees of freedom 6.7291. Probability Level 0.0095.

Table 30. Cross tabulation of pregnancy and lactation rates of jennies from location 5 (California).

	PREGNANT		
LACTATION	YES	NO	Total
YES	17	2	19
	8.9	1.0	9.9
	0.2	0.8	1.0
NO	137	35	172
	71.7	18.3	90.1
	0.0	0.1	0.1
Total	154	37	191
	80.6	19.4	100.0
	0.2	0.9	1.1

Chi-Square with 1 degrees of freedom 1.0569. Probability Level 0.3039.

Population Comparisons:

Lactation: There were significant differences in rates of lactation at Location 1 (Wyoming, Table 35) with the rate in population #3 (24%) (collected October-December) about half that in the other three populations (50+ %) (collected August-October). However at Location 2 (Nevada, Table 36), population #2 at 40% lactating (collected October-December) was 2-3 times higher than populations #3 (12%) and #4 (17%) also collected October-November. Nevada population #1 collected in February was 6% lactating. Location 3 (Oregon) included two populations collected in February with none of 85 mares lactating (Table 37). In contrast, location 4 (Oregon) also collected in February had 32% or 15 of 47 mares lactating from 2 of 3 populations sampled (Table 38). The burros were collected in March and April from 3 populations and 19 jennies or 10.2% from 2 populations were lactating (Table 39).

Table 31. Cross tabulation of pregnancy and lactation rates of mares from location 1 (Wyoming).

	PREGNANT		
LACTATION	YES	NO	Total
YES	87	5	92
	43.7	2.5	46.2
	0.0	0.0	0.0
NO	101	6	107
	50.8	3.0	53.8
	0.0	0.0	0.0
Total	188	11	199
	94.5	5.5	100.0
	0.0	0.0	0.0

Chi-Square with 1 degrees of freedom 0.0028. Probability Level 0.9576.

Table 32. Cross tabulation of pregnancy and lactation rates of mares from location 2 (Nevada).

	PREGNANT		
LACTATION	YES	NO	Total
YES	52	7	59
	24.4	3.3	27.7
	0.7	2.6	3.3
NO	115	39	154
	54.0	18.3	72.3
	0.3	1.0	1.3
Total	167	46	213
	78.4	21.6	100.0
	1.0	3.6	4.6

Chi-Square with 1 degrees of freedom 4.5644. Probability Level 0.0326.

Table 32. Cross tabulation of pregnancy and lactation rates of mares from location 3 (Oregon).

	PREGNANT		
LACTATION	YES	NO	Total
2	57	18	75
	76.0	24.0	100.0
	0.0	0.0	0.0
Total	57	18	75
	76.0	24.0	100.0
	0.0	0.0	0.0

There were no lactating mares recorded at this location.

Table 34. Cross tabulation of pregnancy and lactation rates of mares from location 4 (Oregon).

	PREGNANT		
LACTATION	YES	NO	Total
YES	11	4	15
	23.4	8.5	31.9
	0.0	0.0	0.0
NO	24	8	32
	51.1	17.0	68.1
	0.0	0.0	0.0
Total	35	12	47
	74.5	25.5	100.0
	0.0	0.0	0.0

Chi-Square with 1 degrees of freedom 0.0149. Probability Level 0.9028.

Table 35. Location 1 (Wyoming) lactation rates by population.

POPULATION	LACTATION YES	NO	Total
2	52	42	94
	55.3	44.7	100.0
	2.2	1.8	4.0
3	12	37	49
	24.5	75.5	100.0
	4.6	3.8	8.4
4	12	9	21
	57.1	42.9	100.0
	0.7	0.6	1.2
5	20	29	49
	40.8	59.2	100.0
	0.2	0.2	0.4
Total	96	117	213
	45.1	54.9	100.0
	7.7	6.3	14.0

Chi-Square with 3 degrees of freedom 13.9659. Probability Level 0.0030.

Table 36. Location 2 (Nevada) lactation rates by population.

POPULATION	LACTATION YES	NO	Total
1	1	16	17
	5.9	94.1	100.0
	2.9	1.1	4.0
2	47	69	116
	40.5	59.5	100.0
	6.9	2.6	9.5
3	7	49	56
	12.5	87.5	100.0
	4.7	1.8	6.5
4	4	20	24
	16.7	83.3	100.0
	1.1	0.4	1.5
Total	59	154	213
	27.7	72.3	100.0
	15.5	5.9	21.5

Chi-Square with 3 degrees of freedom 21.4755. Probability Level 0.0001 .

Table 37. Location 3 (Oregon) lactation rates by population.

POPULATION	LACTATION NO	Total
1	48	48
	100.0	100.0
	0.0	0.0
2	27	27
	100.0	100.0
	0.0	0.0
Total	75	75
	100.0	100.0

Table 38. Location 4 (Oregon) lactation rates by population.

POPULATION	LACTATION YES	NO	Total
1	3	8	11
	27.3	72.7	100.0
	0.1	0.0	0.1
2	12	18	30
	40.0	60.0	100.0
	0.6	0.3	0.9
3	0	6	6
	0.0	100.0	100.0
	1.9	0.9	2.8
Total	15	32	47
	31.9	68.1	100.0
	2.6	1.2	3.8

Chi-Square, 2 df 3.8241. P = 0.1478.

Pregnancy: There are indications of population differences in pregnancy rates at both locations 1 and 2 (Tables 40, 41) with only population #3 (91%) in Nevada similar to three of the populations (95-100%) in Wyoming. Population #5 in Wyoming at 80% pregnant was the lowest from that location. There were no significant differences between populations at either of the Oregon locations (Tables 42, 43) with an average pregnancy rate of 75%. Pregnancy rates in the burros also were the same from the three populations with an average rate of 81% Table 44).

Lactating and Pregnant: The proportion of animals pregnant but not lactating ranged from 50 to 57 % at the four horse locations (Tables 31 - 34) but was 72 % for the burros (Table 30). The proportion of mares pregnant and lactating was 0, 23, 24, and 44 % at the horse locations and of jennies was 8.9 %. The proportion of mares neither lactating or pregnant was 3, 17, 18, and 24 % and for the jennies 18 %. This provides substantial variation for analysis in terms of the physical and biochemical variables as sources of demographic information.

Table 39. Location 5 (Burros) lactation rates by population.

POPULATION	LACTATION YES	NO	Total
1	9	37	46
	19.6	80.4	100.0
	4.0	0.5	4.5
2	10	97	107
	9.3	90.7	100.0
	0.1	0.0	0.1
3	0	34	34
	0.0	100.0	100.0
	3.5	0.4	3.8
Total	19	168	187
	10.2	89.8	100.0
	7.5	0.9	8.4

Chi-Square with 2 degrees of freedom 8.3804. Probability Level 0.0151.

Table 40. Location 1 (Wyoming) pregnancy rates by population.

POPULATION	PREGNANT YES	NO	Total
2	86	3	89
	96.6	3.4	100.0
	0.0	0.8	0.9
3	36	0	36
	100.0	0.0	100.0
	0.1	2.0	2.2
4	21	0	21
	100.0	0.0	100.0
	0.1	1.2	1.3
5	41	8	49
	83.7	16.3	100.0
	0.6	9.9	10.5
Total	184	11	195
	94.4	5.6	100.0
	0.8	13.9	14.8

Chi-Square with 3 degrees of freedom 14.7804. Probability Level 0.0020.

Table 41. Location 2 (Nevada) pregnancy rates by population.

POPULATION	PREGNANT YES	NO	Total
1	11	6	17
	64.7	35.3	100.0
	0.4	1.5	1.9
2	89	27	116
	76.7	23.3	100.0
	0.0	0.2	0.2
3	51	5	56
	91.1	8.9	100.0
	1.1	4.2	5.3
4	16	8	24
	66.7	33.3	100.0
	0.4	1.5	2.0
Total	167	46	213
	78.4	21.6	100.0
	2.0	7.3	9.3

Chi-Square with 3 degrees of freedom 9.3369. Probability Level 0.0251.

Table 42. Location 3 (Oregon) pregnancy rates by population.

POPULATION	PREGNANT YES	NO	Total
1	35	13	48
	72.9	27.1	100.0
	0.1	0.2	0.3
2	22	5	27
	81.5	18.5	100.0
	0.1	0.3	0.4
Total	57	18	75
	76.0	24.0	100.0
	0.2	0.5	0.7

Chi-Square with 1 degrees of freedom 0.6950. Probability Level 0.4045.

Table 43. Location 4 (Oregon) pregnancy rates by population.

POPULATION	PREGNANT YES	NO	Total
1	6	5	11
	54.5	45.5	100.0
	0.6	1.7	2.3
2	25	5	30
	83.3	16.7	100.0
	0.3	0.9	1.2
3	4	2	6
	66.7	33.3	100.0
	0.0	0.1	0.2
Total	35	12	47
	74.5	25.5	100.0
	1.0	2.8	3.7

Chi-Square with 2 degrees of freedom 3.7285. Probability Level 0.1550.

Table 44. Location 5 (Burros) pregnancy rates by population.

POPULATION	PREGNANT YES	NO	Total
1	38	8	46
	82.6	17.4	100.0
	0.0	0.0	0.1
2	85	22	107
	79.4	20.6	100.0
	0.0	0.2	0.2
3	29	5	34
	85.3	14.7	100.0
	0.1	0.3	0.4
Total	152	35	187
	81.3	18.7	100.0
	0.1	0.5	0.7

Chi-Square with 2 degrees of freedom 0.6518. Probability Level 0.7219.

EXTENDED CHEMISTRY DATA SET (Wyoming Populations 2 & 3)

This analysis includes data from 21 serum chemistry assays (Table 45) and the physical data in terms of lactation, population, condition, and age.

Population Effects:

When analyzed with location as the sole factor, there was no difference in mean age, weight, and condition index of the two populations. Serum protein, globulins, and potassium were lower in population 2. SGOT, urea, triglycerides, cholesterol, calcium, and phosphorus were higher in population 2.

Lactation Effects:

When analyzed with lactation status as the sole factor, there was no difference in the condition index between the groups (Table 45). However the lactating mares were older ($P < .0001$) and heavier ($P < .004$) than the non-lactating animals. The lactating animals had higher albumin, total bilirubin, direct bilirubin, SGOT, LDH, sodium, and urea levels. Their values for alkaline phosphatase and potassium were lower.

Lactation and Population:

When analyzed with lactation and population as factors, two lactation effects changed with LDH becoming NS and P achieving $P < .05$ (Table 25). Note that SGOT, K, urea, and P are affected by both lactation and location. When age is used as a covariate, the effects of lactation on weight, SGOT, and phosphorus become insignificant (Table 46). The effect of location on LDH barely becomes significant but no other changes in location effects were found.

SUMMARY OF SERUM CHEMISTRY DATA BY LOCATION AND POPULATION

LOCATION:	VARIABLE (Means mg/dl)					
POPULATIONS	Urea	Trigs	Chol	Ca	P	N
All Horses	20.5	117	102	11.6	2.5	543
Wyoming(1)	21.4	75.4	114	10.5	3.3	217
2	22.1	110	125	10.8	3.3	93
3	17.2	34	101	10.6	3.1	49
4	24.7	68	118	9.7	3.2	20
5	23.3	56	105	10.2	3.4	48
ANOVA(P<)	.0001	.0001	.0001	.0004	NS	
Nevada(2)	19.5	133	94	12.3	2.4	212
1	20.3	95	80	11.7	2.7	17
2	17.3	169	99	12.6	2.6	115
3	24.3	95	87	12.0	1.7	56
4	18.4	72	91	12.2	2.8	24
ANOVA	.0001	.02	.007	.004	.0001	
Oregon(3)	21.0	103	93	11.4	1.7	74
1				11.2	1.7	48
2				11.6	1.6	27
ANOVA				NS	NS	
Oregon(4)	18.2	104	136	12.1	2.6	49
1	20.7	70		12.2	2.7	10
2	17.3	64		11.9	2.6	25
3	20.1	286		13.0	2.5	5
ANOVA	.02	.007		NS	NS	
Burros(5)	18.8	333	146	13.4	5.9	173
1	19.0	209	120	13.7	6.6	45
2	18.4	348	152	13.4	6.0	93
3	19.8	465	149	13.4	4.9	34
ANOVA	NS	.08	.05	NS	.0008	
ANOVA (Loc)	.0005	.002	.0001	.0001	.0001	

SUMMARY AND CONCLUSIONS

1. There were significant differences between species, between locations, and between populations from individual locations with respect to physical findings (age, weight, and condition index), reproductive findings (proportion pregnant, lactating, both, or neither), and laboratory findings (serum urea, triglycerides, cholesterol, calcium, and phosphorus). Thus there is variation potentially useful for assessing the reproductive and physiological status of populations and for relating the physiological status of the animals to the recent demographic characteristics of a population and to habitat and environmental variation.

2. The physical findings suggest that the Nevada populations of mares were younger, lighter for their age, and in poorer condition than the animals from the other locations. The Wyoming populations were intermediate in age, heaviest for age, and their average condition index was the highest for the 3 locations with data available. The Oregon populations were oldest on average and similar to the Wyoming population in weight. There were significant differences between populations in weight (age corrected) at both the Wyoming and Nevada locations but not Oregon (location 3). There were differences in condition index among the four Nevada populations and in age for the two Oregon-3 populations.

3. The reproductive findings indicate the highest pregnancy rate in the Wyoming animals and lower rates in the Nevada mares with significant population differences at both locations. The Wyoming mares had a higher proportion lactating than those from Nevada. There were significant population differences at both locations. The incidence of lactation at the two Oregon locations differed but these data were collected later in the season (February) and thus cannot be directly compared to the Wyoming and Nevada data. Nonreproductive mares were most frequent in the Nevada and Oregon-3 populations but these included the youngest populations.

4. Serum chemistry findings indicate between location differences for all of the five chemistries and significant population differences within location for Wyoming and Nevada horses in all chemistries except phosphorus(P) in Wyoming (which was highest in P for all the horse locations). Cholesterol, phosphorus, and urea were higher in the Wyoming mares whereas triglycerides and calcium were lower. Serum phosphorus was lowest in mares from Oregon (location 3). Accentuation of the differences in lipid pattern may be seen by expressing the trig/cholesterol data as a ratio with the value greater than one in Nevada and less than one in Wyoming animals. Most of the horse samples with hyperlipemia occureed in the samples from the Nevada horses as well. It appears likely that the energy sources utilized were different and that the Nevada animals may be using

internal fat reserves as well. The differences between locations in serum phosphorus are substantial and suggest wide differences in availability of this essential element in the food. Additional assays and direct analysis of forage would be useful to clarify these relationships but they may offer insight into limiting nutrients on the different ranges.

5. There were significant interactions between the physical, reproductive and serum chemistry variables. Lactating animals were older both in horses and burros and lactating mares were heavier. Lactating mares had lower serum phosphorus in each population. Other lactation effects on the five serum chemistries were location and population dependent. In the mares there were AGE effects on alkaline phosphatase, triglycerides, calcium, and phosphorus. In the extended chemistry series (Wyoming animals) there were CONDITION effects on serum protein, serum globulins, SGOT, urea, triglycerides, calcium, and phosphorus. These condition effects could be separated from lactation and age effects. Thus the battery of standard assays for assessment of condition effects should be expanded to include serum protein, serum albumin (globulins are calculated from the difference), and SGOT.

6. Lactation effects within the Wyoming populations, using the extended chemistry set, were noted for albumin, bilirubin (total and direct), SGOT, sodium, potassium, urea, and phosphorus. These effects were separable from the population differences reflected in urea, cholesterol, calcium, phosphorus, triglycerides, SGOT, protein, and globulins. These population differences could be attributed to the apparent poorer condition of some mares in population 3 relative to 2 - particularly in the lactating females. Population 3 had a significantly smaller percentage of lactating mares (25 vs 55%, but the same high percentage of pregnant mares (>95%).

7. The effects of pregnancy on serum chemistries were minimal relative to the effects of age, lactation, condition, and population. However, pregnant mares had higher condition index scores than non-pregnant mares with pregnant and non-lactating mares (47.4) having the highest scores. This was of the same mean age as the non-pregnant and non-lactating group so that age was not a factor.

8. There is a need for further analysis of these data with respect to census information on the individual populations, information on population habitat status, and information on the likely recent foods used by the animals.

9. I conclude that serum chemistry information can provide information on condition of animals from populations that may be relatable to local habitat events and food resources and possibly to age specific reproduction including foal survival.

Table 22. SUMMARY OF PHYSICAL DATA BY LOCATION AND POPULATION

		VARIABLE					
POPULATION	N,N,N[1]	Age (Mon)		Weight (lb)		Condition	
All Horses	536,552,	52.1	1.8			46.8	.4
Wyoming	217,208,137	54.8	2.8	877	9.6	50.5	.6
2	94,91,84	56.8	3.9	849	14.0	50.7	.7
3	49,43,37	62.3	5.4	860	20.3	50.8	1.1
4	21,21,13	49.0	8.2	899	29.1	48.5	1.9
5	49,49	46.3	5.4	938	19.0		
ANOVA		NS		.002		NS	
Nevada	210,184	40.8	2.7	667	10.2	42.6	.5
1	,,9					35.5	2.0
2	116,110,64	36.9	2.7	716	11.9	44.0	.7
3	56,55,54	39.2	3.9	537	16.8	41.1	.8
4	24,19,21	46.7	6.0	754	28.5	45.2	1.3
ANOVA		NS		.0000		.0001	
Oregon	74,74	61.3	4.4	855	16.1	49.0	.9
1	47,47,47	75.4	5.7	859	16.5	49.0	1.1
2	27,27,8	36.7	7.5	848	21.7	48.8	2.7
ANOVA		.0001		NS		NS	
Oregon	44, ,	75.1	5.7				
1	10,	85.0	10.7				
2	29,	72.2	6.3				
3	5,	72.0	15				
ANOVA		NS					
Burros		37.2	2.9	345			
1	46,	39.5	4.3				
2	93,9	38.4	3.0	388	21.7		
3	34,33	30.7	5.0	303	11.3		
ANOVA		NS		.002			
ANOVA (Location)		.0001		.0001		.0001	

[1]The 'N' values are for age, weight, and condition respectively. Data are presented as means and standard errors.

SUMMARY OF REPRODUCTIVE DATA BY POPULATION

	Lactating		Pregnant		Lact & Preg		Neith	
Population	N	%	N	%	N	%	N	%
All Horses	166	31.1	447	83.7	150	28.1	71	13.3
Wyoming (1)	92	46.2	188	94.5	87	43.7	6	3.0
2	52	55	86	97				
3	12	25	36	100	12	25	0	0
4	12	57	21	100	12	57	0	0
5	20	41	41	84				
Chi^2	.003		.002					
Nevada (2)	59	27.7	167	78.4	52	24.4	39	18.3
1	1	6	11	65				
2	47	40	89	77				
3	7	12	51	91				
4	4	17	16	67				
Chi^2	.0001		.025					
Oregon (3)	0	0	57	76.0	0	0	18	24.0
1	0	0	35	73	0	0		27.0
2	0	0	22	82	0	0		18.0
Chi^2			NS					
Oregon (4)	15	31.9	35	74.5	11	23.4	4	8.5
1	3	27	6	55				
2	12	40	25	83				
3	0	0	4	67				
Chi^2			NS					
Burros (5)	19	9.9	154	80.6	17	8.9	35	18.3
1	9	20	38	83				
2	10	9	85	79				
3	0	0	29	85				
Chi^2	.02		NS					
Location Chi^2	.0000		.0000		.009			

Table 25. Extended serum chemistries by lactation and population for Wyoming (location 1) populations 2 and 3.

MEANS

ASSAY	Lact -> Yes		No		P<	
Pop.->	2	3	2	3	Lac	Loc
N	20	12	23	37		
Age	70	84	29	40	.0000	NS
Weight	888	933	817	832	.003	NS
Condition	50.9	50	52.6	51.1	NS	NS
Protein	7.6	8.1	7.6	8.1	NS	.0008
Albumin	3.5	3.9	3.6	3.3	.0008	NS
Globulins	4.1	4.2	4.0	4.8	NS	.003
T. Bili.	3.1	3.5	2.6	1.3	.0001	NS
D. Bili.	.28	.28	.22	.13	.0003	.09
SGOT	428	384	399	301	.02	.004
Alk P.	250	253	304	304	.005	NS
GGT	46	35	38	38	NS	NS
LDH	721	621	631	572	NS	.06
Na	145	146	144	142	.003	NS
K	4.9	4.7	5.2	6.5	.0001	.05
Cl	102	99.7	100	101	NS	NS
CO2	22.2	25.6	24.1	21.9	NS	NS
Urea	22.2	21.3	21.8	15.9	.015	.005
Creat.	1.4	1.5	1.6	1.4	NS	NS
Uric A.	.44	.5	.44	.44	NS	NS
Glucose	143	135	135	131	NS	NS
Trigs	63	33	62	34	NS	.02
Chol	123	103	121	100	NS	.0001
Ca	11.1	10.5	11.7	10.6	NS	.004
P	3.49	2.85	4.12	3.23	.05	.003

There were significant lactation-location interactions in the ANOVA's for: urea .04, albumin .0000, t. bilirubin .02, potassium .005, chloride .03, CO2 .004, and creatinine .02.

Table 45. Comparisons of physical data, hormone values, and serum chemistries of lactating and non-lactating feral mares from Wyoming (Location 1).

Assay	Lactating	Dry	P <=
N	33	60	
Age - months	75	36	.0000
Condition - index	50.6	51.7	.38
Weight - pounds	904	825	.004
Progesterone - ng/ml	3.23	4.46	.35
Estradiol - pg/ml	374	502	.25
PMSG - units/ml	1.97	2.93	.49
Serum protein - g/dl	7.78	7.89	.42
Albumin - g/dl	3.66	3.43	.002
Bilirubin - mg/dl	3.22	1.81	.0001
Direct bilirubin - mg/dl	0.28	0.17	.0001
SGOT - IU/l	409	339	.007
Alkaline P'tase - IU/L	252	304	.004
GGT - IU/l	42	38	.27
LDH - IU/l	683	595	.04
Sodium - meq/l	146	142	.001
Potassium - meq/l	4.82	5.97	.0000
Chloride - meq/l	101	100	.67
CO2 - meq/l	23.5	22.8	.42
Serum urea N - mg/dl	21.9	19.7	.004
Creatinine - mg/dl	1.45	1.46	.87
Uric acid - mg/dl	0.46	0.47	.73
Glucose - mg/dl	140	133	.31
Cholesterol - mg/dl	116	108	.14
Triglycerides - mg/dl	52	45	.58
Calcium - mg/dl	10.9	11.0	.59
Phosphorus - mg/dl	3.26	3.58	.22

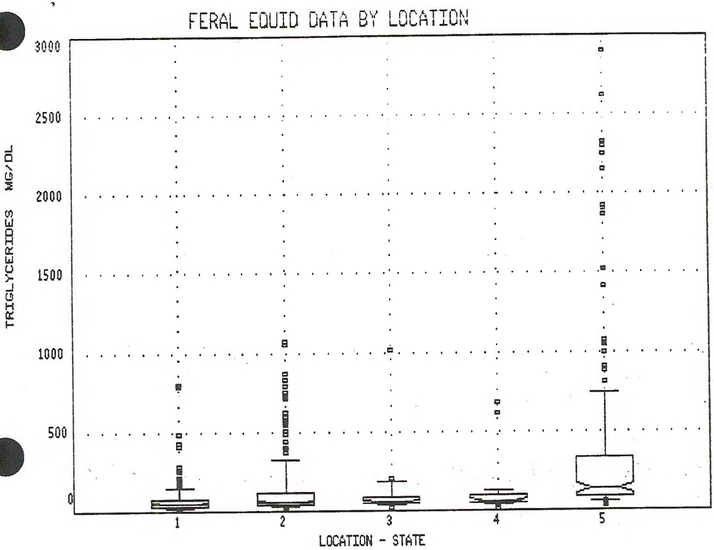
Table 46. 2-Way ANOVA's of serum chemistries by lactation and population for Wyoming (location 1) populations 2 and 3. Effects of age and condition as covariates are analyzed separately and together.

P Values

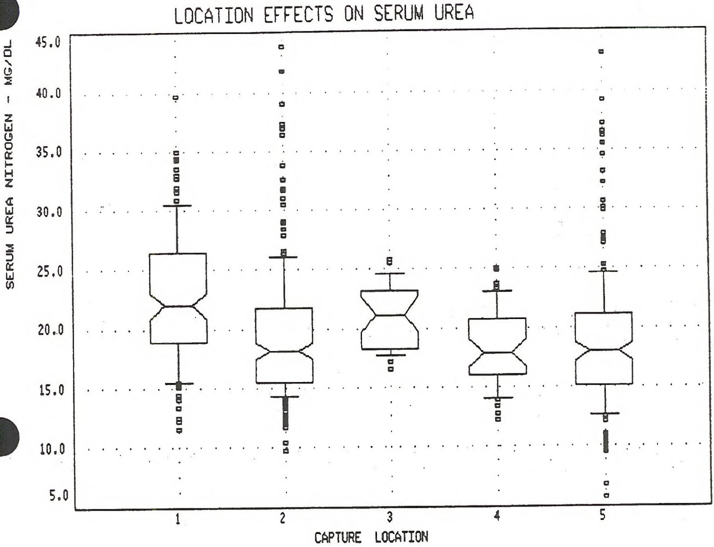
ASSAY Covar->	None		Age		Condition		Age + Cond.	
Factor->	Lact	Pop	Lact	Pop	Lact	Pop	Lact	Pop
Age	.0000	NS			.0001	.09		
Weight	.003	NS	.07	NS	.0001	NS	.08	NS
Condition	NS	NS	NS	NS				
Protein	NS	.0008	NS	.0009	NS	.02	NS	.02
Albumin	.0008	NS	.003	NS	.003	NS	.03	NS
Globulins	NS	.003	NS	.003	NS	.04	NS	.04
T. Bil.	.0001	NS	.004	NS	.006	NS	.04	NS
D. Bili.	.0003	NS	.005	NS	.02	NS	.06	NS
SGOT	.02	.004	.09	.003	.08	.09	NS	.06
Alk P.	.005	NS	NS	NS	.03	NS	NS	NS
GGT	NS	NS	NS	.06	NS	NS	NS	NS
LDH	NS	.06	NS	.04	.06	NS	NS	.08
Na	.003	NS	.02	NS	.002	NS	.02	NS
K	.0001	.05	.001	.04	.001	.08	.002	.06
Cl	NS	NS	NS	NS	NS	NS	NS	NS
CO2	NS	NS	NS	NS	NS	NS	NS	NS
Urea	.015	.005	.07	.004	.10	.02	NS	.03
Creat.	NS	NS	NS	NS	NS	NS	NS	NS
Uric A.	NS	NS	NS	NS	NS	NS	NS	NS
Glucose	NS	NS	NS	NS	NS	NS	NS	NS
Trigs	NS	.02	NS	.02	NS	.10	NS	.07
Chol	NS	.0001	NS	.0000	NS	.0000	NS	.0000
Ca	NS	.004	NS	.01	NS	.01	NS	.03
P	.05	.003	NS	.007	.05	.07	NS	NS

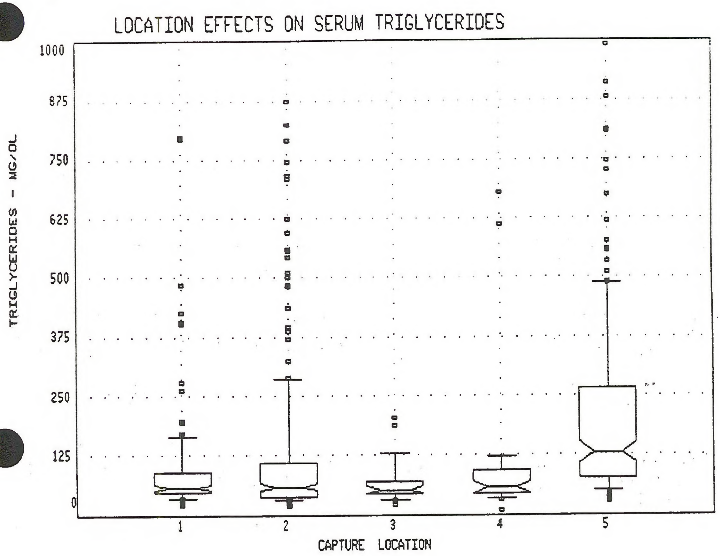
The sample size was 92 mares. Significant F values (P<)for age as a covariate were obtained for: alkaline phosphatase .015, calcium .03, body weight .05, and condition index .008. With condition as a covariate significant values were: weight .004, age .007, albumin .01, direct bilirubin .02, K .003, Cl .02, and CO2 .01.

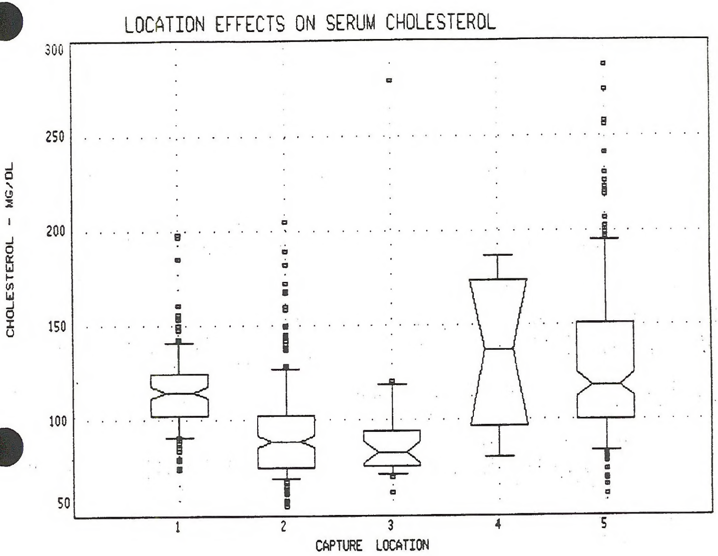
FIGURES - BOX PLOTS

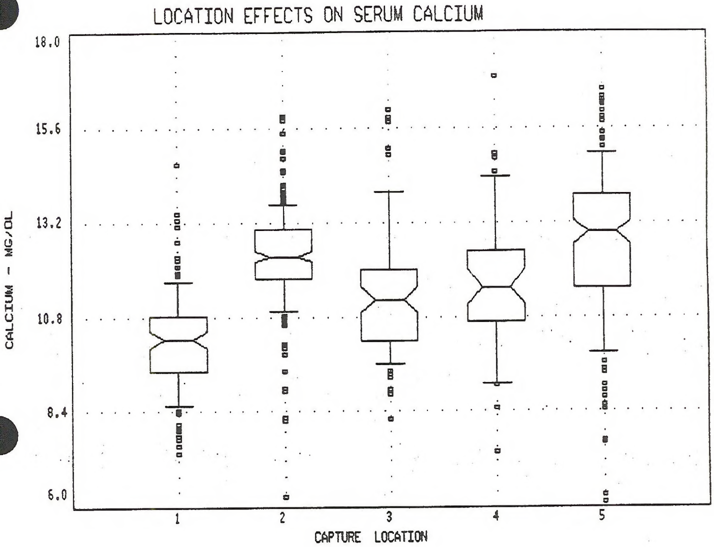


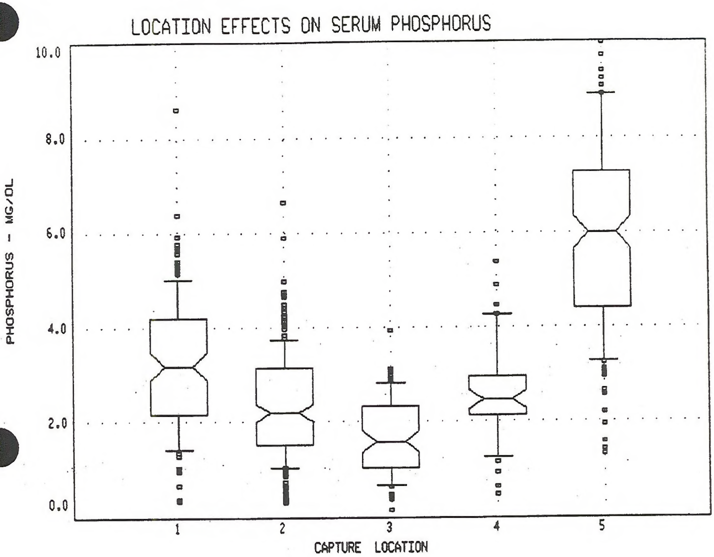
FERAL EQUID DATA BY LOCATION
TRIGLYCERIDES MG/DL
3000
2500
2000
1500
1000
500
0
1
2
3
4
5
LOCATION - STATE

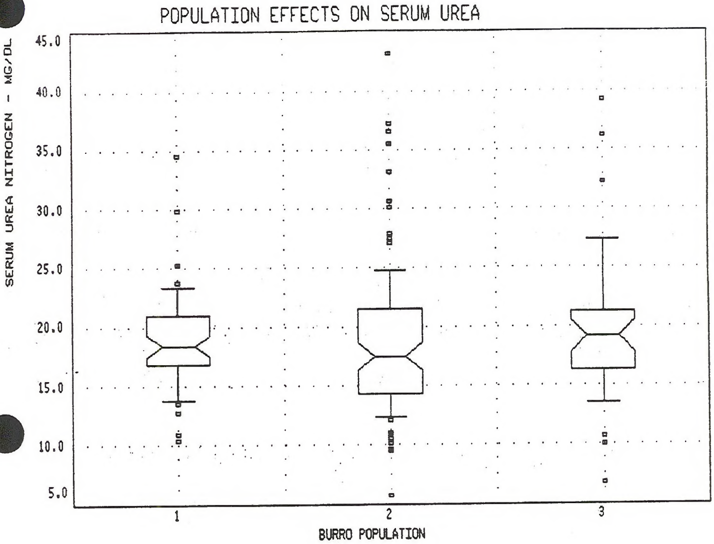

LOCATION EFFECTS ON SERUM UREA
SERUM UREA NITROGEN - MG/DL
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
1
2
3
4
5
CAPTURE LOCATION

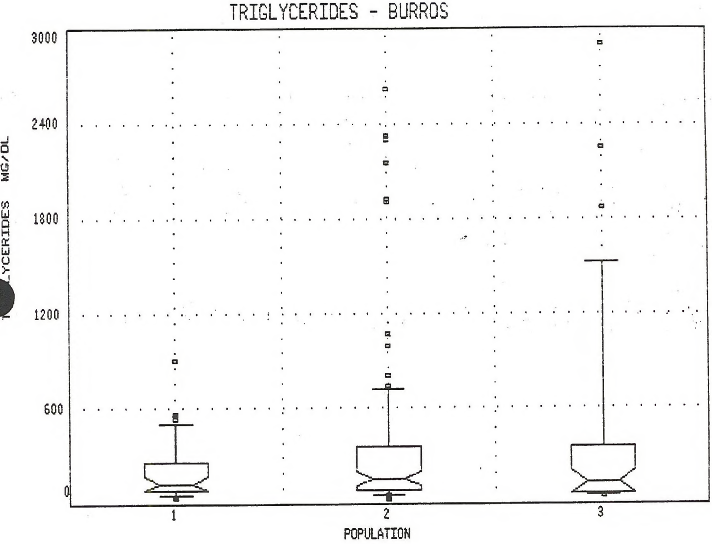

LOCATION EFFECTS ON SERUM TRIGLYCERIDES
TRIGLYCERIDES - MG/DL
1000
875
750
625
500
375
250
125
0
1
2
3
4
5
CAPTURE LOCATION

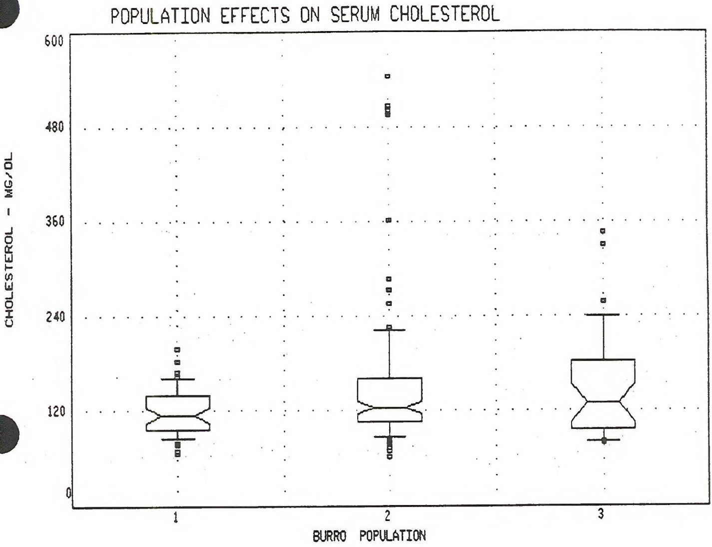

LOCATION EFFECTS ON SERUM CHOLESTEROL
CHOLESTEROL - MG/DL
300
250
200
150
100
50
1
2
3
4
5
CAPTURE LOCATION

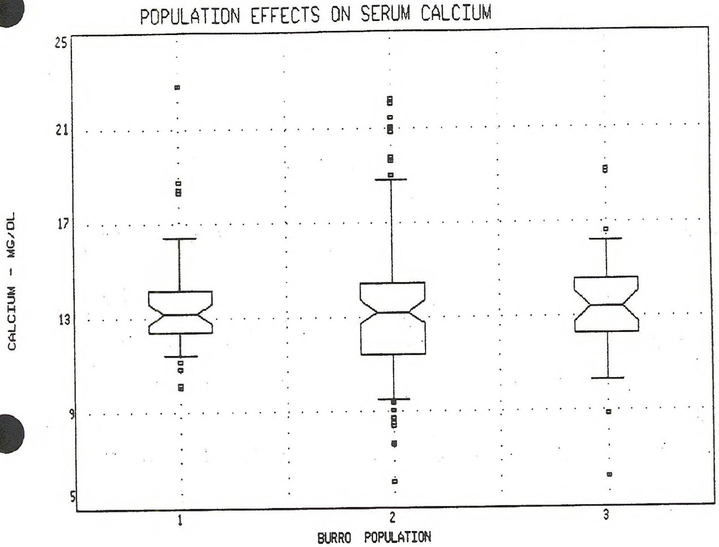

LOCATION EFFECTS ON SERUM CALCIUM
18.0
15.6
13.2
10.8
8.4
6.0
CALCIUM - MG/DL
1
2
3
4
5
CAPTURE LOCATION

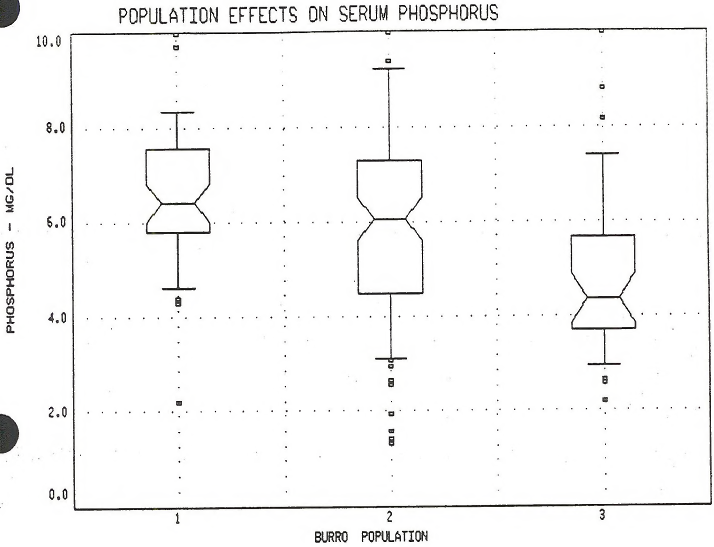

LOCATION EFFECTS ON SERUM PHOSPHORUS
PHOSPHORUS - MG/DL
10.0
8.0
6.0
4.0
2.0
0.0
1
2
3
4
5
CAPTURE LOCATION

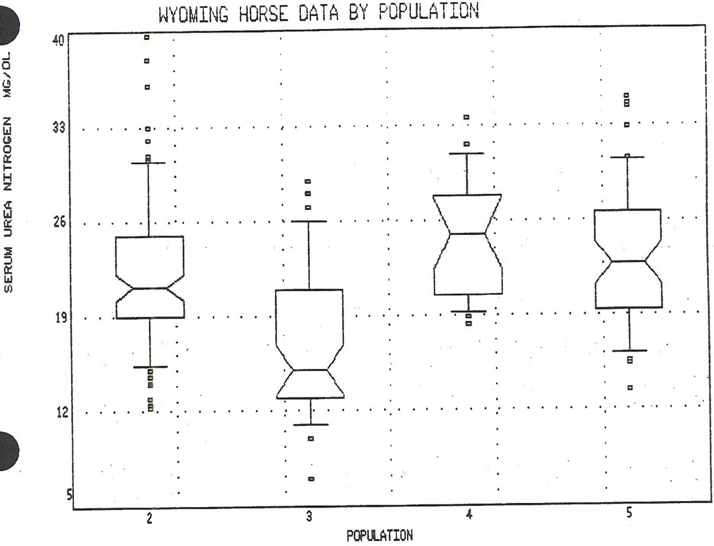

POPULATION EFFECTS ON SERUM UREA
SERUM UREA NITROGEN - MG/DL
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
1
2
3
BURRO POPULATION

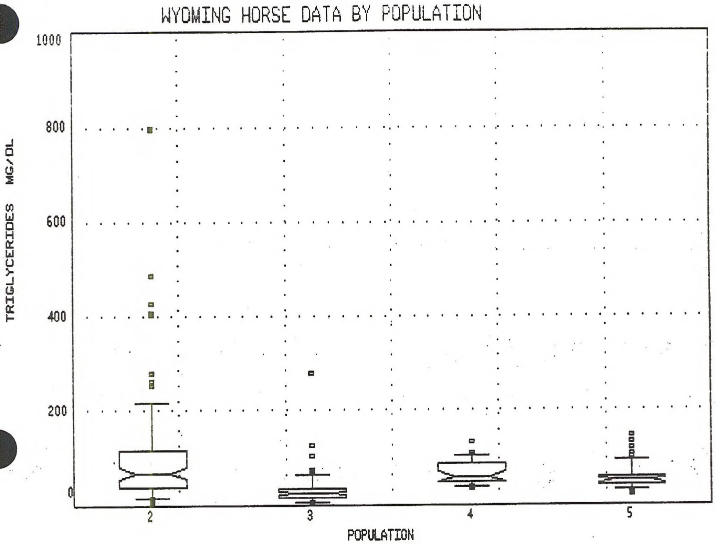

TRIGLYCERIDES - BURROS
3000
2400
1800
1200
600
0
TRIGLYCERIDES MG/DL
1
2
3
POPULATION

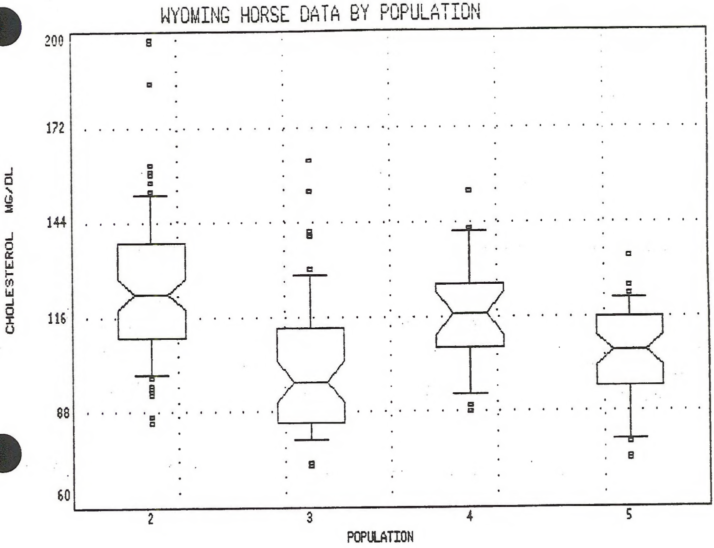

POPULATION EFFECTS ON SERUM CHOLESTEROL
CHOLESTEROL - MG/DL
600
480
360
240
120
0
1
2
3
BURRO POPULATION

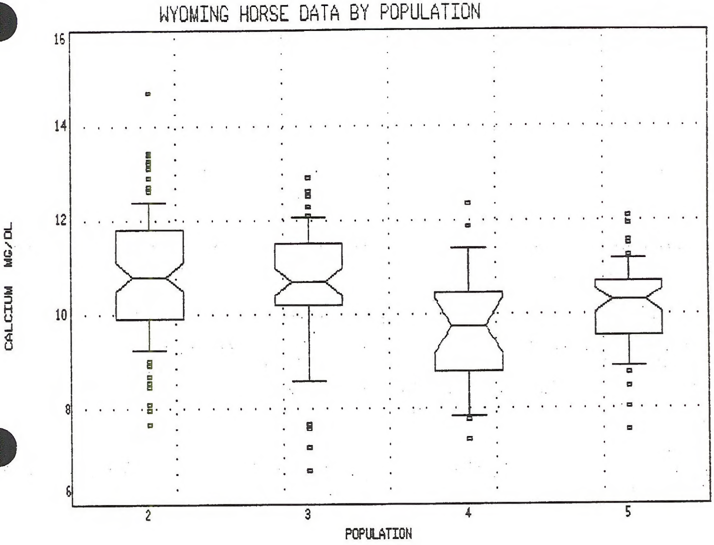

POPULATION EFFECTS ON SERUM CALCIUM
25
21
17
13
9
5
CALCIUM - MG/DL
1
2
3
BURRO POPULATION

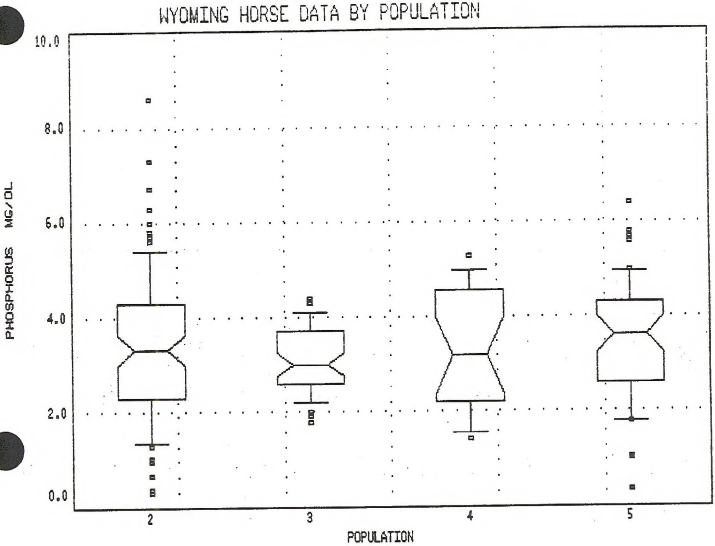

POPULATION EFFECTS ON SERUM PHOSPHORUS
PHOSPHORUS - MG/DL
10.0
8.0
6.0
4.0
2.0
0.0
1
2
3
BURRO POPULATION


WYOMING HORSE DATA BY POPULATION
SERUM UREA NITROGEN MG/DL
40
33
26
19
12
5
2
3
4
5
POPULATION

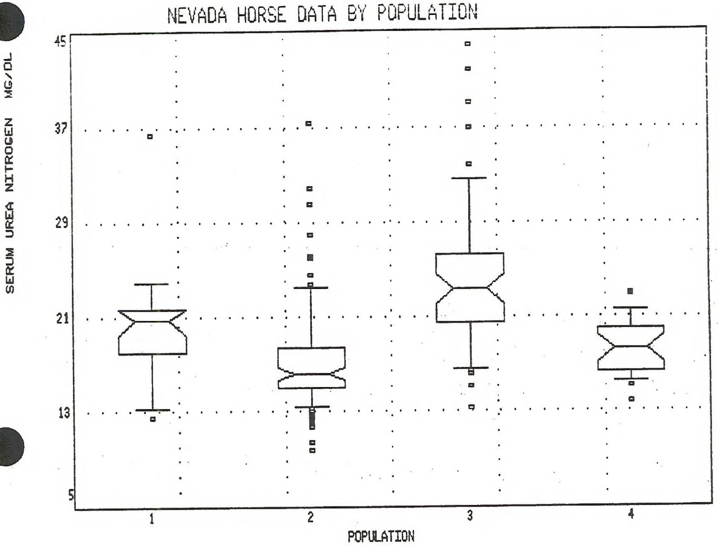

WYOMING HORSE DATA BY POPULATION
1000
800
600
400
200
0
TRIGLYCERIDES MG/DL
2
3
4
5
POPULATION

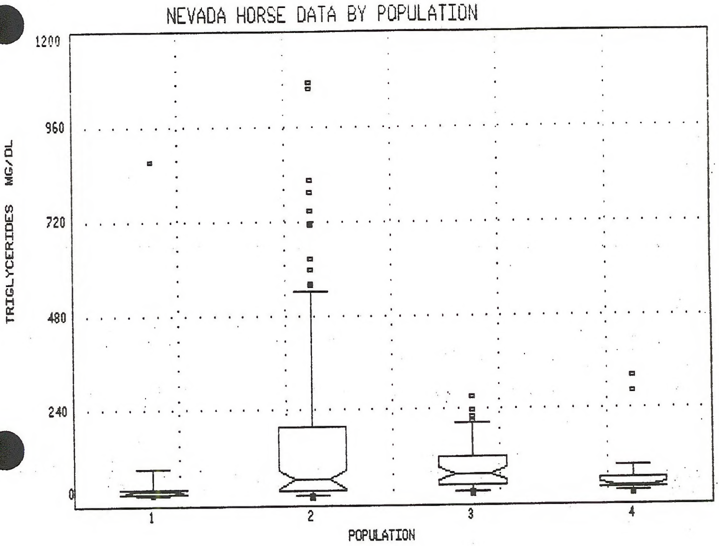

WYOMING HORSE DATA BY POPULATION
200
172
144
116
88
60
CHOLESTEROL MG/DL
2
3
4
5
POPULATION

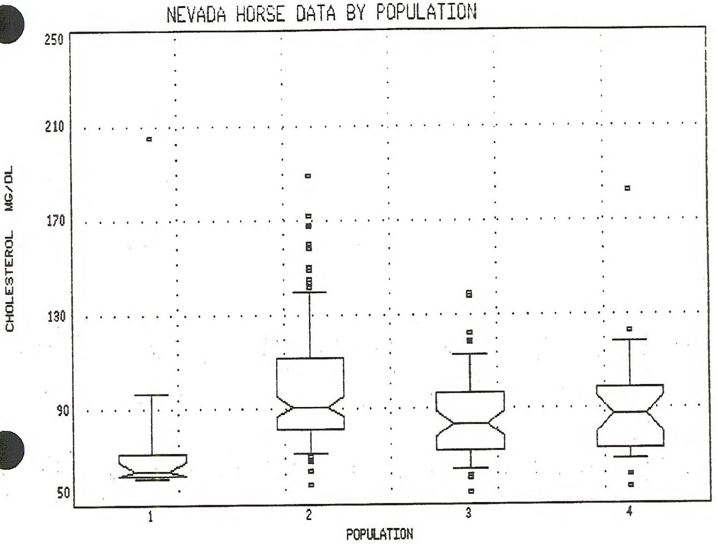

WYOMING HORSE DATA BY POPULATION
CALCIUM MG/DL
16
14
12
10
8
6
2
3
4
5
POPULATION

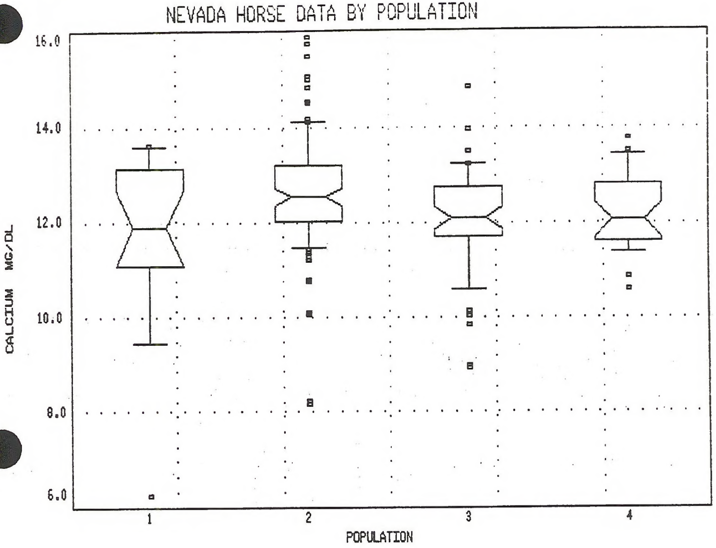


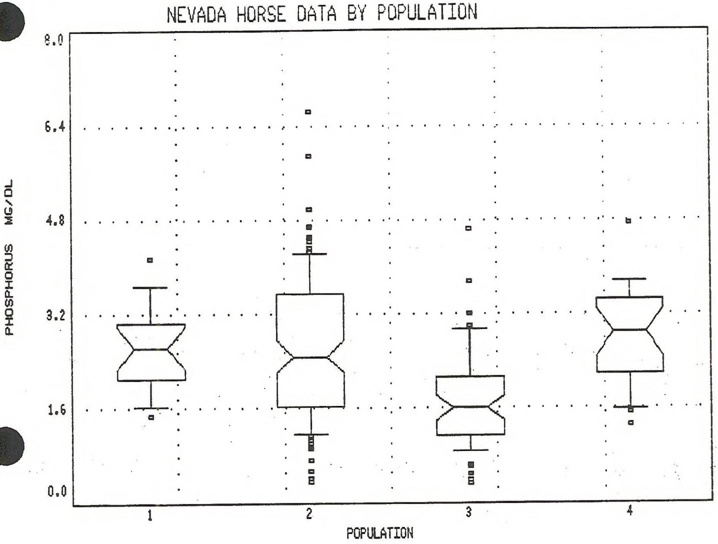
WYOMING HORSE DATA BY POPULATION
10.0
8.0
6.0
4.0
2.0
0.0
PHOSPHORUS MG/DL
2
3
4
5
POPULATION

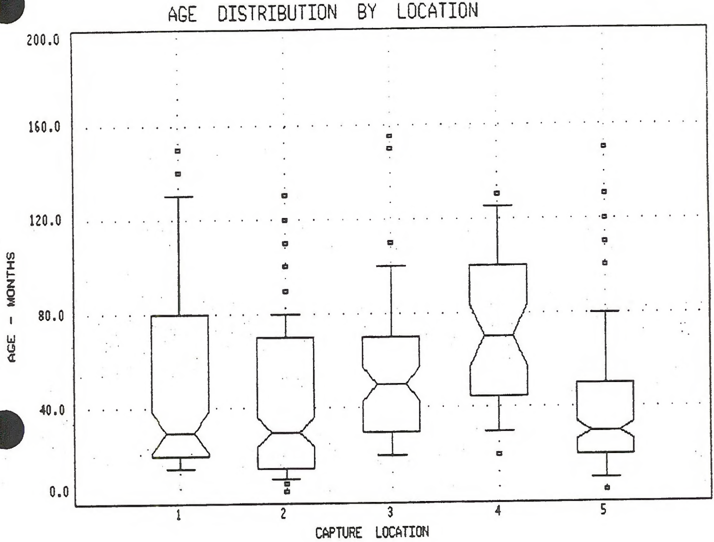

NEVADA HORSE DATA BY POPULATION
SERUM UREA NITROGEN MG/DL
45
37
29
21
13
5
1
2
3
4
POPULATION

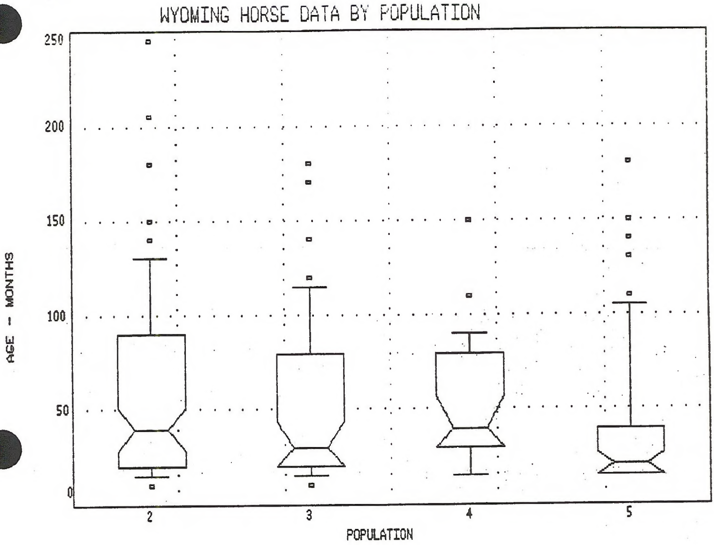

NEVADA HORSE DATA BY POPULATION
TRIGLYCERIDES MG/DL
1200
960
720
480
240
0
1
2
3
4
POPULATION

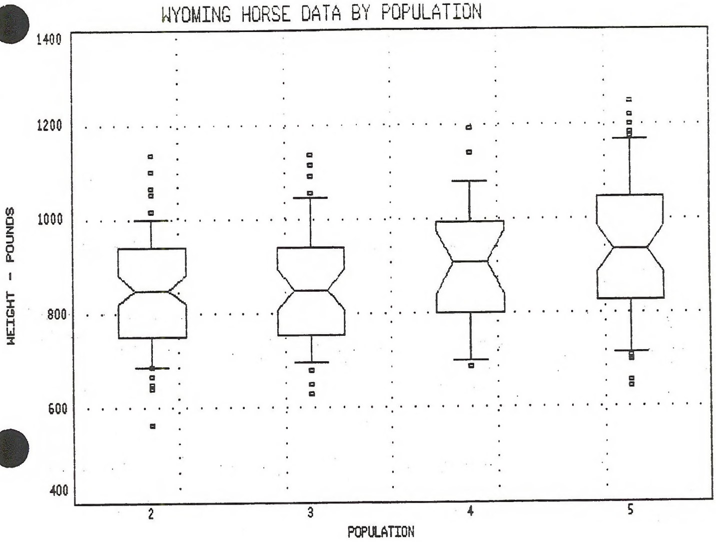

NEVADA HORSE DATA BY POPULATION
250
210
170
130
90
50
CHOLESTEROL MG/DL
1
2
3
4
POPULATION

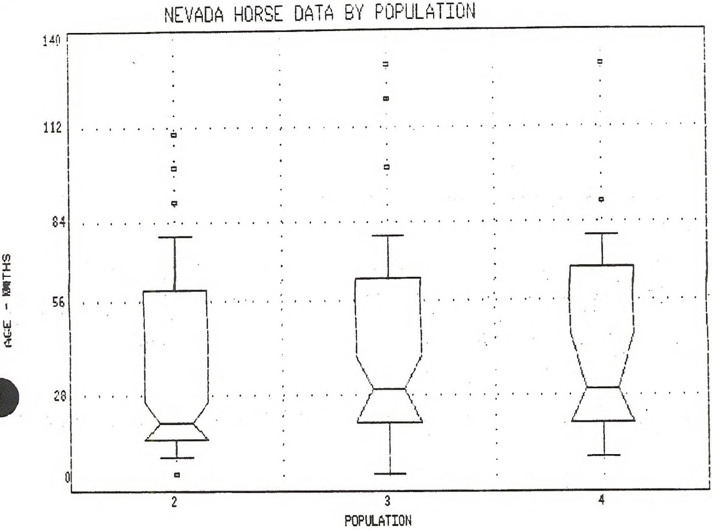

NEVADA HORSE DATA BY POPULATION
16.0
14.0
12.0
10.0
8.0
6.0
CALCIUM MG/DL
1
2
3
4
POPULATION

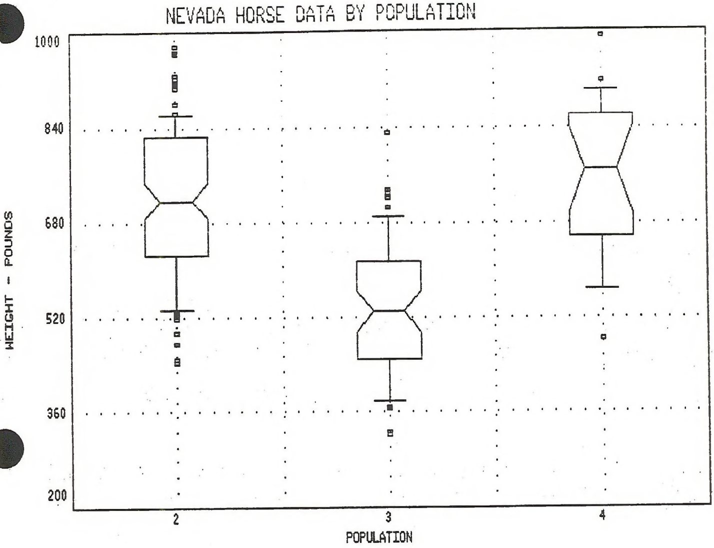

NEVADA HORSE DATA BY POPULATION
8.0
6.4
4.8
3.2
1.6
0.0
PHOSPHORUS MG/DL
1
2
3
4
POPULATION

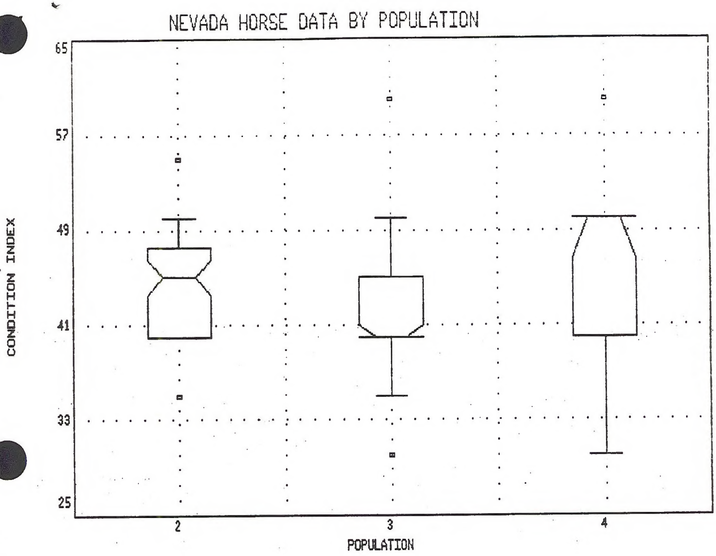

AGE DISTRIBUTION BY LOCATION
AGE - MONTHS
200.0
160.0
120.0
80.0
40.0
0.0
1
2
3
4
5
CAPTURE LOCATION


WYOMING HORSE DATA BY POPULATION
AGE - MONTHS
250
200
150
100
50
0
2
3
4
5
POPULATION


WYOMING HORSE DATA BY POPULATION
1400
1200
1000
800
600
400
WEIGHT - POUNDS
2
3
4
5
POPULATION


NEVADA HORSE DATA BY POPULATION
140
112
84
56
28
0
AGE - MONTHS
2
3
4
POPULATION


NEVADA HORSE DATA BY POPULATION
1000
840
680
520
360
200
WEIGHT - POUNDS
2
3
4
POPULATION


NEVADA HORSE DATA BY POPULATION
65
57
49
41
33
25
CONDITION INDEX
2
3
4
POPULATION